Measurement of the traffic noise climate at the Traveller Unit at the new Red Cow Interchange on the M50, Dublin.

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Signature Approvals:

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Ms. Sharon O’Grady, South Dublin Co. Council.

Revision/Update Information:
Revision History

Date	Author	Revision	Status Draft/Approved	Summary of Changes
30/10/08	Diarmuid Keaney	Rev 1	Release	

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EXECUTIVE SUMMARY

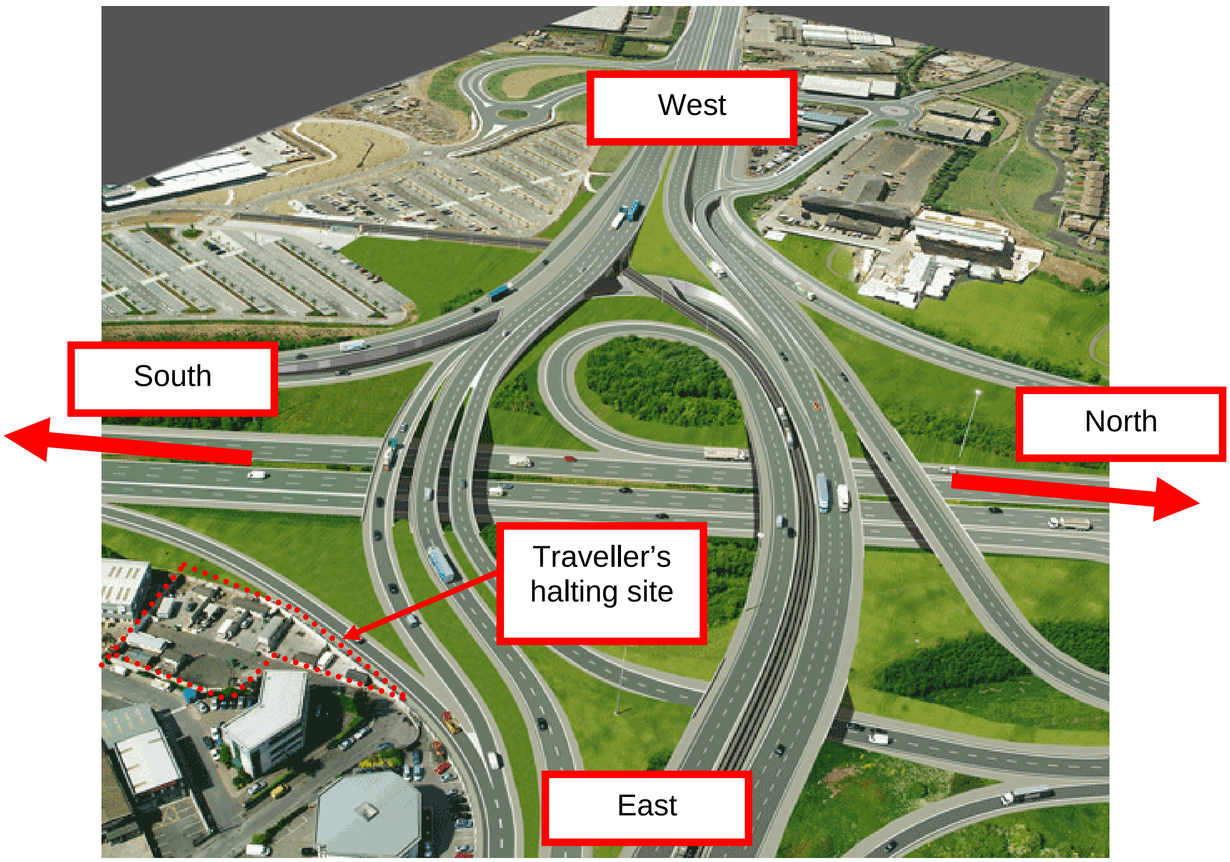
A noise survey of ambient noise levels in the vicinity of the Traveller unit on at the new M50 Red Cow Interchange has been carried out in order to obtain baseline information in relation to assessing the impact of traffic noise from the nearby junction.

Night measurements would indicate that the noise levels at the Traveller unit are in excess of the NRA guidance values when an Lden prediction is conducted. Noise mitigation measures will be required in terms of a site barrier as well as enhanced sound insulation to the proposed dwellings.

1 Introduction

In October 2008, ICAN Acoustics were commissioned by Ms. Sharon O'Grady, Senior Architect at South Dublin County Council to examine the existing noise climate in the vicinity of the new M50 Red Cow Interchange.

The site under investigation relates to a Traveller's Halting Site to the South East of the interchange which has been highlighted with a dotted red line (See Picture 1 below).



Picture1: Shows the M50 Red Cow Interchange.

We have conducted a daytime and night time measurements at the M50/Red Cow Traveller Halting Site and traffic noise levels are high. Our daytime noise measurements were somewhat affected by the fact that there was construction noise present during our daytime site measurements. Our night time measurements however are representative of the likely noise exposure at the site due to the fact that there was not construction noise at the site.

2 Measurement Procedure

The shortened Calculation of Road Traffic Noise (CTRN) method was used to measure the daytime and night time traffic noise exposure at the site.

Picture 2: Noise measurements being conducted at the perimeter of the Traveller unit.

3 Measurement Equipment

Bruel & Kjaer 2260 Sound Level Meter with Building Acoustics Application
Sound Level Meter, Bruel & Kjaer Type: 2260 Serial No 2497359 Calibration Cert: CA3327, Calibration Certificate Dated: 21/09/2007 (2 year calibration)
Microphone, Bruel & Kjaer Type: 4189 Serial No 2503186 Calibration Cert: CA3326, Calibration Certificate Dated: 21/09/2007 (2 year calibration)
Type 1 instrument.

Field Calibration
Using the Type 4231 Sound Level Calibrator, which produces a sound level of 93.8dB re. 2x10-5 Pa, at a frequency of 1kHz. The instrumentation used was calibrated before and after use of each measurement with a recorded maximum deviation of –0.02dB

Calibrator, Bruel & Kjaer Type: 4231 with Serial No 2499109
Calibration Cert: CA3569
Dated: 16th January 2008 (1 Year Calibration).

4 Measurement results.

Site measurements were conducted using an outdoor microphone system. Construction noise are likely to have had adverse effect on the daytime measurements, the night time measurements were un affected and are representative of traffic noise levels at the site. While the junction was still under construction, all of the new lanes at the interchange were in use and therefore traffic noise measurements would be representative of normal use, with the exception of the daytime measurements which were affected by nearby construction noise.

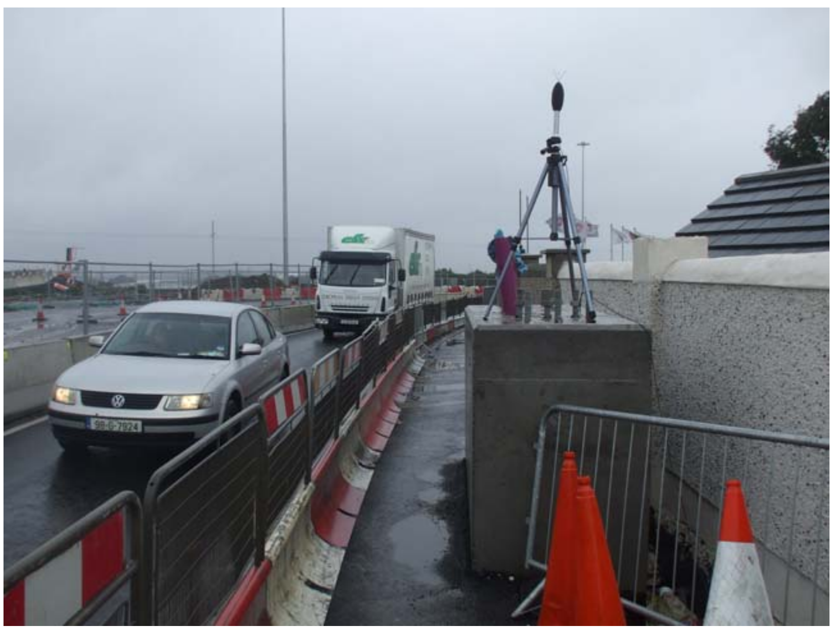
4.1 Daytime Measurements

Site notes:
Traffic noise dominant; however there was a significant contribution from distant rock breakers and earth moving equipment. Garda helicopter hovering for approximately five minutes nearby during hourly measurement. Conditions would have prevented the measurement of a representative road traffic noise level. While there was no rain present during our measurements the road surface was wet from a rain shower earlier in the day.

Weather: South westerly wind with a 5minute average of 2.8m/second. No rain present.
11th of September 2008
(Note: Construction noise & helicopter activity affecting accuracy)

Daytime	**LAeq**	**Sources**
Daytime Hour 1: 14:00hrs to 15:00Hrs	75.0dB	Traffic and construction noise
Daytime Hour 2: 15:00hrs to 16:00Hrs	75.5dB	Traffic and construction noise
Daytime Hour 3: 16:00hrs to 17:00hrs	74.1dB	Traffic and construction noise

Table 1: Shows daytime measurements conducted on the site perimeter over three consecutive hours.



Picture 3: Shows the placement of the outdoor microphone during the daytime hours positioned 1.2m above the boundary wall to allow a free-field measurement to be conducted, minimising the effects of reflection from the boundary wall.

4.2 Night time measurements

There was no construction noise present during the night measurements and all measurements are representative of traffic noise at the site.

11th of September 2008 to 12th Sept 2008

Night time	LAeq	Sources
Night Hours from 23:00hrs to 00:00hrs	65.5dB	Traffic noise only.
Night Hours from 00:00hrs to 01:00hrs	63.9dB	Traffic noise only.
Night Hours from 01:00hrs to 02:00hrs	60.9dB	Traffic noise only.

Table 2: Shows night time measurements conducted on the site perimeter over three consecutive hours.

Picture 4: Shows the placement of the outdoor microphone during the night time hours positioned 1.2m above the boundary wall to allow a free-field measurement to be conducted, minimising the effects of reflection from the boundary wall.

5 Noise assessment

5.1 NRA Guidance (Source: NRA Guidance Document 2004)

Guidelines for the Treatment of Noise and Vibration in National Road Schemes (Rev1, 25th October 2004)

The various conversion analyses conducted in the validation studies highlighted greater variance for the L_{night} conversions than observed for the L_{den} conversions and this was particularly evident at noise levels below 60dB $L_{A10(18\ hour)}$ free field. This variance has the potential to result in some degree of uncertainty in performing a robust assessment of the L_{night} criterion for national road schemes. Taking cognisance of this variability and since the L_{den} criterion already adopted by the Authority incorporates a noise component for day time (07:00 to 19:00), and weighted evening (+5dB) and night (+10dB) components, the Authority now considers it appropriate to temporarily retract the L_{night} criterion until further guidance on the implementation of appropriate L_{night} criteria and a harmonised reliable prediction methodology is recommended by the EU. Therefore, until further notice, all future national road schemes should be designed, where feasible, to meet the following:

day-evening-night 60dB L_{den} (free field residential façade criterion)

This design goal has been shown to be significantly more onerous than the 68dB(A) $L_{10(18\ hour)}$ value previously employed on national road schemes. This design goal is applicable to new road schemes only. In EIS terms, this means that it is to be applied to existing sensitive receptors in respect of both the year of opening and the design year (i.e. 15 years after projected year of opening).

Following confirmation of the EIS, the issue of noise mitigation for new receptors is a matter for the Planning Authority within the planning legislation. The Authority accepts that it may not always be sustainable to provide adequate mitigation in order to achieve the design goal. Therefore, a structured approach should be taken in order to ameliorate as far as practicable road traffic noise through the consideration of measures such as alignment changes, barrier type (e.g. earth mounds), low noise road surfaces etc.

Mitigation measures are only deemed necessary when the following three conditions are satisfied at designated sensitive receptors:

(a) the combined expected maximum traffic noise level, i.e. the relevant noise level, from the proposed road scheme together with other traffic in the vicinity is greater than the design goal;

(b) the relevant noise level is at least 1dB more than the expected traffic noise level without the proposed road scheme in place;

(c) the contribution to the increase in the relevant noise level from the proposed road scheme is at least 1dB.

These conditions will ensure that mitigation measures arising out of this process are based upon the impact of the scheme under consideration. The Authority considers that the adoption of this more onerous criterion as an absolute level for the mitigation of noise impacts from a proposed scheme is more appropriate than restricting noise level increases to a specified threshold above existing background values. In general, it is difficult to assess and compare background noise levels at locations away from the influence of regular traffic because noise levels at such locations vary significantly during the day and day to-day noise measurements are often not as repeatable as for locations near regular traffic flows.
This is primarily due to the existence of a range of highly variable noise sources encountered at such locations, e.g. children playing, birdsong, grass cutting, agricultural activity, home heating boilers etc. Due to this daily variation, it is not possible to ascertain the $L_{A10(18hour)}$ from $L_{A10(3hour)}$ measurements as normally undertaken at sites influenced by traffic noise. Therefore, the only way to reliably assess the existing background noise level for such a location is to measure the $L_{A10(18hour)}$ at each individual

residence. While this is possible, it is not very practical to undertake such monitoring at every impacted residence on a proposed scheme.

5.2 BS8233:1999 Sound insulation and noise reduction for buildings.

This standard provides information on the design of internal acoustics for buildings. It deals with the control of noise from the outside of the building, noise from plant and services within in, and room acoustics for non critical situations.

BS8233 also provides internal noise criteria for various types of use, such as internal noise criteria for bedrooms, in each case the lower value is considered as a good standard and the upper figure is considered as a reasonable standard.

Reasonable standard for a Bedroom LAeq=35dB

Good Standard LAeq=30dB

Peaks shall not exceed an LAmax of 45dB.

5.3 *WHO Guideline Values for Community Noise*

These guidelines indicate noise levels which should not be exceeded in order to prevent annoyance from noise during the daytime and sleep disturbance at night-time

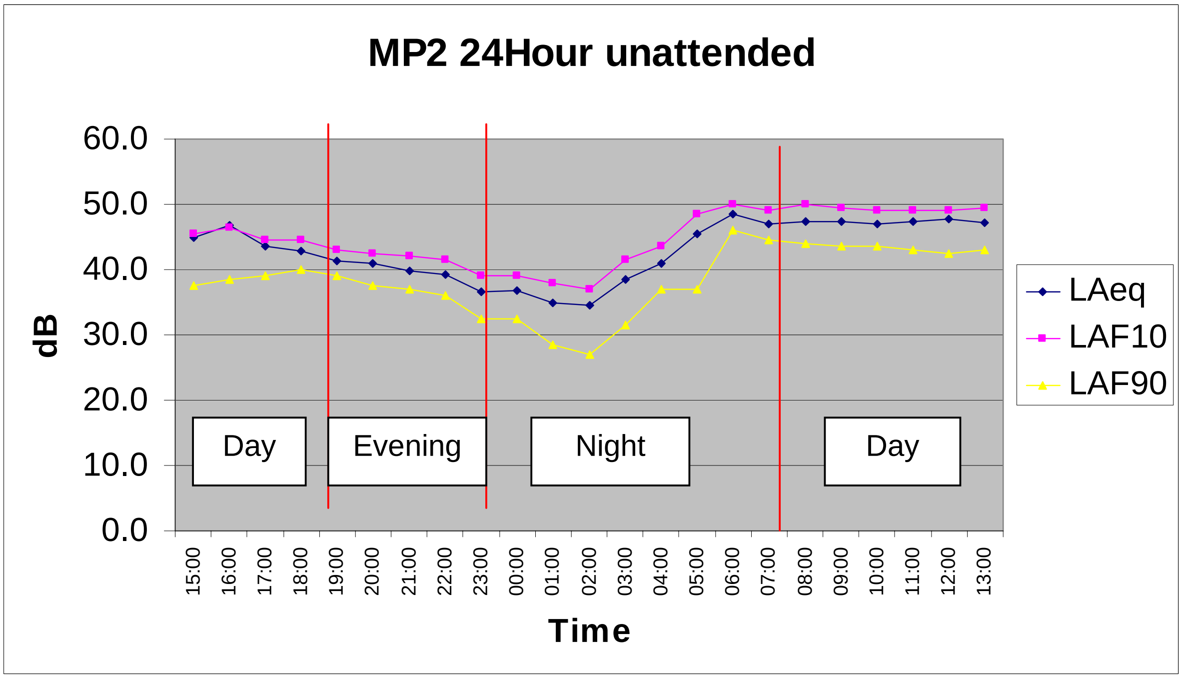
		L_{Aeq}	L_{Amax}
Outdoor living area	serious annoyance, daytime and evening	55 dB	
	Moderate annoyance, daytime and evening	50 dB	
Dwelling, indoors	Speech intelligibility and moderate annoyance, daytime and evening	35 dB	
Inside bedrooms	Sleep disturbance, night-time	30 dB	45 dB
Outside bedrooms (outdoor values)	Sleep disturbance, window open	45 dB	60 dB

6 Findings & Calculations

While the daytime metrics maybe somewhat affected by the construction noise, the night time figures are 60+dB(A), therefore some mitigation will be required.

Lden = $10XLog\left(\frac{1}{24}\right)\left(12X10^{\frac{Lday}{10}}+4X10^{\frac{5+Levening}{10}}+8X10^{\frac{10+Lnight}{10}}\right)dB(A)$

While it was not possible to complete a derived Daytime LAeq,16hour, we can assume that the traffic at the site will follow a typical pattern as is shown below which we have extracted from measurements on another project at approximately 280m from an Irish motorway. The LAeq,8hour night measurement for this site was 42dB.



Graph 1: Shows measurements conducted 280m from at busy Irish Motorway.

While there is no shortened method for night-time assessment, a measurement during the first three hours of a night or the last three hours of the night is log averaged as an approximation of the 8-hour night time LAeq.

Using the measurements obtained on the 11th of September 2008 to 12th Sept 2008

Night time	LAeq	Sources
Night Hours from 23:00hrs to 00:00hrs	65.5dB	Traffic noise only.
Night Hours from 00:00hrs to 01:00hrs	63.9dB	Traffic noise only.
Night Hours from 01:00hrs to 02:00hrs	60.9dB	Traffic noise only.

Table 2: Shows night time measurements conducted on the site perimeter over three consecutive hours.

The log average for the three consecutive night hour measurements equates to: 63.8

Therefore the LAeq,night = 64dB (Log. Average)
The measurements at this site are 64dB – 42dB = 22dB higher than our measurements at another location. If we increase the day time and evening levels by 22dB, we will get a close approximation to the daytime and evening noise levels expected at the site.

Period	Our reference site	Red Cow Traveller site.	Difference
Daytime	46dB(A)	Predicted 68dB(A)	22dB(A)
Evening	40dB(A)	Predicted 62dB(A)	22dB(A)
Night	42dB(A)	Measured 64dB(A)	22dB(A)

Using:

Lden = $10 X Log\left(\frac{1}{24}\right)\left(12 X 10^{\frac{Lday}{10}} + 4 X 10^{\frac{5+Levening}{10}} + 8 X 10^{\frac{10+Lnight}{10}}\right) dB(A)$

The predicted Lden=65.5dB at this site is +5.5dB above the NRA design goal of 60dB

7 Noise mitigation measures

7.1 The use of noise barriers

It is our understanding that dormer bungalows are to be constructed on site which we believe is going to present a serious challenge in terms of noise mitigation.

Barriers are a well known source of protection, however they have limitations too. Their performance is greatly affected by:

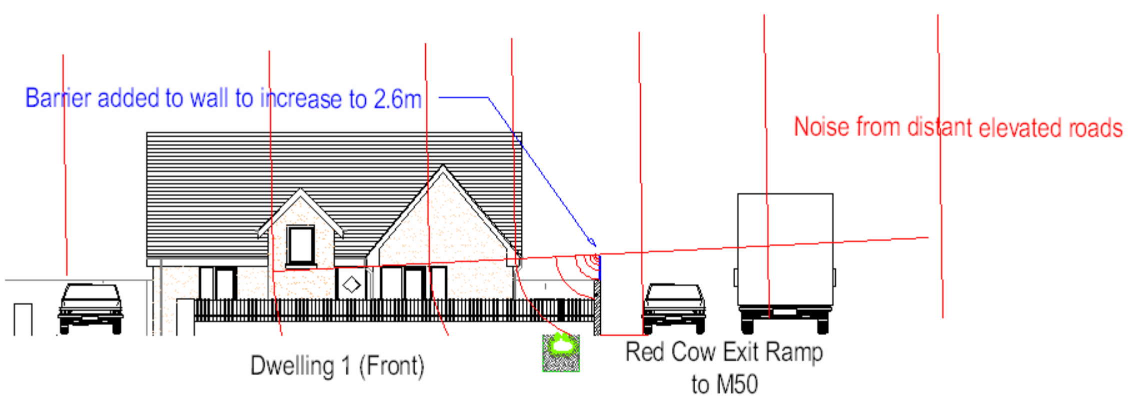
- the distance between the source and the receiver
- the height of the source
- the height of the receiver
- the proximity of the barrier to the source and to the receiver
- the ground cover (hard or soft) between the source and barrier and between the barrier and receiver.
- The density of the barrier and it having no gaps (imperforate).

General points about barriers

- Barriers are most effective when they are located close to the source or receiver
- When they protect low-rise housing rather than high-rise
- Generally, the taller the barrier the better but, as the rate of improvement with height diminishes progressively, there will come a point where increasing the height becomes relatively ineffective.
- They are particularly effective when the site slopes away from the source
- They should usually extend well beyond the ends of a site to be protected.
- Sound transmitted through the barrier should be negligible compared with sound travelling over and around it.
- The barrier material should be imperforate.
- Trees or any form of vegetation are not a recognised acoustic barrier. The initial drawings provided to us did show 'planting to enhance sound buffering', however they would be better referenced as a visual screen.

The existing site boundary wall measures 2.0m from the inside the site and we have been advised that the project Architects would be reluctant to consider anything in excess of 2.6m high. While a wall/barrier 2.6m high would provide some screening in the garden areas close to the barrier, it would offer little or no screening to the dormer bedrooms approximately 4m from the ground. It will be essential to consider enhanced sound insulation as well as an appropriate room ventilation system that will not compromise the traffic break-in noise to the bedrooms on the dormer 1st floor.

The Planning CAD file for the proposed development shows the existing wall at 1.8m and even with a proposed height increase (to be checked by a structural engineer) of 2.6m, we can see that barrier will offer little or no barrier effect to noise from distant traffic at the junction which is elevated well above the site level. The West bound route increases in elevation as it moves away from the Traveller site increasing the height and reducing the performance of the barrier for both inbound and outbound city traffic. The barrier will however provide reasonable screening from near low height traffic such as the traffic shown on the Red Cow exit ramp below. A truck with a high level exhaust pipe (such as a refuse lorry) or even refrigerated truck with a diesel refrigeration unit will have little difficulty in bypassing a 2.6m barrier.



7.2 Enhanced sound insulation

Enhanced building performance is achieved by improving sound insulation and increasing its resistance to the break-in of traffic noise. The fact that the proposed properties are to be a dormer bungalow will present a serious challenge in terms of noise reduction. A dormer bungalow is normally created by using a low mass structure (wooden construction) on the upper floor inside the roof space. All bedrooms are classed as noise sensitive areas and a low mass structure is generally acoustically weak unless special treatments have been applied.

Generally speaking, masonry walls have better sound insulation that other elements in the building, so you will need to consider the specification of the dormer roof build-up, the windows and methods of ventilation.

Walls or roof sections built of lightweight materials have a lower sound insulation that masonry walls at low frequencies. As road traffic noise peaks at low frequencies, the resulting outside to inside level difference for traffic can be as low as 25dB in some cases. On noisy sites, lightweight cladding should be avoided unless specifically designed to provide lightweight cladding.

7.3 Design Layouts

Layout methods: adequate distance between the source and noise sensitive building or area; screening by natural barriers, other buildings, or non-critical rooms in a building. It is our understanding that the house design has been completed and due to limited space on the site there is not scope to change the layout at this late stage in the project.

8 Conclusion

Measurements of the night time traffic noise level would indicate that the noise levels at the site are particularly high. The derived LAeq,8hour for the night time period was 64dB.

Using 24hour measurements from another Irish motorway we have derived the expected evening and daytime level (which was not possible to measure due to construction noise) at the site during the daytime and evening hours. Our derived Lden at the side was Lden=65.5dB which is +5.5dB above the NRA design goal of 60dB

The proposed increase in barrier height to 2.6m on the site perimeter will protect the site garden areas somewhat, particularly garden areas close to the barrier, however it will offer no protection to the proposed 1st floor dormer roofs of the proposed dwellings. The fact that the proposed dormers in the bungalow are to be used for sleeping presents a difficult challenge as they are the areas of the building exposed to the greatest local and distant traffic noise. Coupled with exposure to traffic noise, the dormer roof structure is low in mass and typically has a lower resistance to traffic break-in noise. Enhanced sound insulation in the dormer roof space will be required and consideration will need to be given to ventilation & glazing without compromising the sound resistance of the building. Careful detailing as well as break-in calculations will be required for the proposed build up and the ground floor rooms should also be assessed as part of the study. It is quiet likely that dwellings furthest from the boundary wall at road side may need enhanced sound insulation.

While some of the garden areas will be protected by the proposed barrier, high level exhaust pipes and diesel refrigeration units on heavy goods vehicles in the nearby slip lane to the M50 will easily bypass the barrier with no attenuation. Therefore while the barrier will assist in reducing the over all daytime, evening and night time level in the garden, it will offer no protection to occasional loud events created by higher vehicles with high level noise sources.

At this point in time it may be worth considering increasing the boundary wall to the proposed finished height and conducting noise measurements in the garden areas at sitting height and at 4m from the ground level to determine the typical noise exposure over 24 hour period. It would be essential that measurements are conducted on day when the construction noise at the site has ceased or at least is far enough away from the site so that it will not affect the measurements at the site.

The design criteria set out in BS8233:1999 ‘Sound insulation and noise reduction for buildings’ and World Health Organisation WHO Guideline Values for Community Noise (See Section 5.2 and 5.3) should be used to assess the Garden, Living Room and Bedrooms at the proposed dwellings prior to design detailing or construction.

Terminology.

Decibel (dB): The decibel is a unit of level, which denotes the ratio between two quantities that are proportional to the power; the number of decibels corresponding to the ratio of two powers is ten times the logarithm to the base 10 of this ratio.

dB(A) : A weighted sound pressure level (S.P.L.) approximately equivalent to the human ear frequency response to noise.

The "A" suffix denotes the fact that the sound levels have been "A-weighted" in order to account for the non-linear frequency response of human hearing. All sound levels in this report are expressed in terms of decibels (dB) relative to $2x10^{-5}$ Pa.

Equivalent Continuous (A) Weighted Sound Level [$L_{Aeq\ T}$]:
This can be regarded as a notional level, which would, in the course of the measuring period (T), cause the same (A) weighted sound energy to be received as that due to the actual sound over the actual measuring period.

LAmax : It is the maximum A-weighted sound pressure level captured at the assessment position.

LA10 is the "A weighted" noise levels that are exceeded for 10% of each sample period.

LA90 is the "A weighted" noise levels that are exceeded for 90% of each sample period. This is term used to measure the background noise level in an area. Typical daytime background noise levels range from an LA90=18dB in a remote rural areas, through 30 to 40 LA90 in "typical" or "quiet" suburban areas, to 50 to 60 LA90 for busy urban areas

Hertz (Hz): The unit of frequency equivalent to one cycle per. second.

Sound pressure level (SPL) or sound level L_p is a logarithmic measure of the root-mean-square sound pressure of a sound relative to a reference value (at the threshold of hearing). It is measured in decibel (dB).